basis often makes around 30 percent of what he or she bills the client, although this varies widely from firm to firm.

Some employment interviewers work on a salary-plus-commission basis because they fill difficult or highly specialized positions requiring long periods of search. The salary is usually small by normal standards; however, it guarantees these individuals security through slow times. The commission provides the incentive and opportunity for higher earnings.

Some personnel supply firms employ new workers for a 2- to 3-month probationary period during which they draw a regular salary. This gives new workers time to develop their skills and acquire clients while simultaneously giving employers an opportunity to evaluate them. If hired, their earnings are then usually based on commission.

Related Occupations

Employment interviewers serve as intermediaries for jobseekers and employers. Workers in several other occupations do similar jobs. Personnel officers, for example, screen and help hire new employees, but they concern themselves mainly with the hiring needs of the firm; they never represent individual jobseekers. Personnel officers may also have additional duties in areas such as payroll or benefits management.

Career counselors help students and alumni find jobs, but they primarily emphasize career counseling and decision making, not placement. Counselors in community organizations and vocational rehabilitation facilities help clients find jobs, but they also assist with drug or alcohol dependencies, housing, transportation, child care, and other problems that stand in the way of finding and keeping a job.

Sources of Additional Information

For information on a career as an employment interviewer/counselor, contact:

☛ National Association of Personnel Services, 3133 Mt. Vernon Ave., Alexandria, VA 22305. Internet: **http://www.napsweb.org**

☛ American Staffing Association, 277 South Washington St., Suite 200, Alexandria, VA 22314. Internet: **http://www.natss.org**

For information on a career as an employment interviewer in State employment security offices, contact:

☛ Interstate Conference of Employment Security Agencies, 444 North Capitol St. NW., Suite 142, Washington, DC 20001. Internet: **http://www.icesa.org**

Engineering, Natural Science, and Computer and Information Systems Managers

(O*NET 13017A, 13017B, and 13017C)

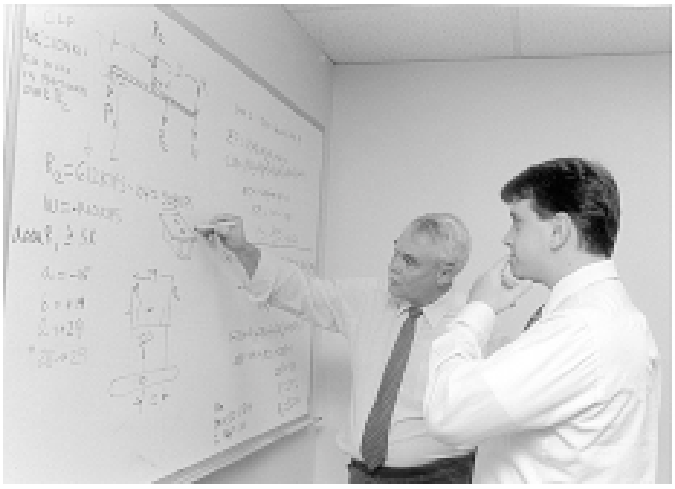
Significant Points

- Projected job growth stems primarily from rapid growth among computer-related occupations.
- Employers prefer managers with advanced technical knowledge and strong communication and administrative skills.

Nature of the Work

Engineering, natural science, and computer and information systems managers plan, coordinate, and direct research, design, production, and computer-related activities. They may supervise engineers, scientists, technicians, computer specialists, and information technology workers, along with support personnel.

These managers use advanced technical knowledge of engineering, science, and computer and information systems to oversee a variety of activities. They determine scientific and technical goals within broad outlines provided by top management. These goals may include the redesigning of an aircraft, improvements in manufacturing processes, the development of large computer networks, or advances in scientific research. Managers make detailed plans for the accomplishment of these goals—for example, working with their staff, they may develop the overall concepts of a new product or identify technical problems standing in the way of project completion.



Engineering managers direct the technical work of their staff.

To perform effectively, they must also possess knowledge of administrative procedures, such as budgeting, hiring, and supervision. These managers propose budgets for projects and programs, and make decisions on staff training and equipment purchases. They hire and assign scientists, engineers, computer specialists, information technology workers, and support personnel to carry out specific parts of the projects. They supervise the work of these employees, review their output, and establish administrative procedures and policies.

In addition, these managers use communication skills extensively. They spend a great deal of time coordinating the activities of their unit with other units or organizations. They confer with higher levels of management; with financial, production, marketing, and other managers; and with contractors and equipment and materials suppliers.

Engineering managers supervise people who design and develop machinery, products, systems, and processes; or direct and coordinate production, operations, quality assurance, testing, or maintenance in industrial plants. Many are plant engineers, who direct and coordinate the design, installation, operation, and maintenance of equipment and machinery in industrial plants. Others manage research and development teams that produce new products and processes or improve existing ones.

Natural science managers oversee the work of life and physical scientists, including agricultural scientists, chemists, biologists, geologists, medical scientists, and physicists. These managers direct research and development projects, and coordinate activities such as testing, quality control, and production. They may work on basic research projects or on commercial activities. Science managers sometimes conduct their own research in addition to managing the work of others.

Computer and information systems managers direct the work of systems analysts, computer programmers, and other computer-related workers. These managers plan and coordinate activities such as the installation and upgrading of hardware and software; programming and systems design; the development of computer networks; and the implementation of Internet and intranet sites. They analyze the computer and information needs of their organization and determine personnel and equipment requirements. They assign and review the work of their subordinates, and purchase necessary equipment.

Working Conditions
Engineering, natural science, and computer and information systems managers spend most of their time in an office. Some managers, however, may also work in laboratories or industrial plants, where they are normally exposed to the same conditions as research scientists and may occasionally be exposed to the same conditions as production workers. Most managers work at least 40 hours a week and may work much longer on occasion to meet project deadlines. Some may experience considerable pressure in meeting technical or scientific goals within short timeframes or tight budgets.

Employment
Engineering, natural science, and computer and information systems managers held about 326,000 jobs in 1998. About 1 in 3 works in services industries, primarily for firms providing computer and data processing, engineering and architectural, or research and testing services. Manufacturing industries employ another third. Manufacturing industries with the largest employment include industrial machinery and equipment, electronic and other electrical equipment, transportation equipment, instruments, and chemicals. Other large employers include government agencies, communications and utilities companies, and financial and insurance firms.

Training, Other Qualifications, and Advancement
Strong technical knowledge is essential for engineering, natural science, and computer and information systems managers, who must understand and guide the work of their subordinates and explain the work in non-technical terms to senior management and potential customers. Therefore, these management positions usually require work experience and formal education similar to that of engineers, mathematicians, scientists, or computer professionals.

Most engineering managers begin their careers as engineers, after completing a bachelor's degree in the field. To advance to higher level positions, engineers generally must assume management responsibility. To fill management positions, employers seek engineers who possess administrative and communications skills in addition to technical knowledge in their specialty. Many engineers gain these skills by obtaining master's degrees in engineering management or business administration. Employers often pay for such training; in large firms, some courses required in these degree programs may be offered on-site.

Many science managers begin their careers as chemists, biologists, geologists, or scientists in other disciplines. Most scientists engaged in basic research have a Ph.D.; some in applied research and other activities may have a bachelor's or master's degree. Science managers must be specialists in the work they supervise. In addition, employers prefer managers with communication and administrative skills and, increasingly, familiarity with computers. Graduate programs allow scientists to augment their undergraduate training with instruction in other fields, such as management or computer technology. Given the rapid pace of scientific developments, science managers must continuously upgrade their knowledge.

Many computer and information systems managers have experience as systems analysts; others may have experience as computer engineers, programmers, or operators, or in other computer occupations. A bachelor's degree is usually required for management positions and a graduate degree is often preferred by employers. However, a few computer and information systems managers may have only an associate degree. Employers seek managers who have experience with the specific software or technology to be used on the job. In addition to technical skills, employers also seek managers who have business and interpersonal skills.

Engineering, natural science, and computer and information systems managers may advance to progressively higher leadership positions within their discipline. Some may become managers in non-technical areas such as marketing, human resources, or sales. In high technology firms, managers in non-technical areas often must possess the same specialized knowledge as managers in technical areas. For example, employers in an engineering firm may prefer to hire experienced engineers as sales people because the complex services offered by the firm can only be marketed by someone with specialized engineering knowledge.

Job Outlook
Employment of engineering, natural science, and computer and information systems managers is expected to increase much faster than the average for all occupations through the year 2008. Technological advancements will increase the employment of engineers, scientists, and computer-related workers; as a result, the demand for managers to direct these workers will also increase. In addition, job openings will result from the need to replace managers who retire or move into other occupations. Opportunities for obtaining a management position will be best for workers with advanced technical knowledge and strong communication and administrative skills.

Underlying the growth of engineering and natural science managers are competitive pressures and advancing technologies which require companies to update and improve products and services more frequently. Investment in facilities and equipment to expand research and output should increase the need for engineering and science managers. Faster-than-average employment growth among electrical, electronics, and civil engineers will provide strong employment opportunities for engineering managers in these areas. Among scientists, faster-than-average growth in the employment of biologists and medical scientists will provide similar opportunities for natural science managers.

Employment of computer and information systems managers is expected to grow rapidly due to the increasing use of information technologies. In order to remain competitive, firms will continue to install sophisticated computer networks, set up Internet and intranet sites, and engage in electronic commerce. The fast-paced expansion of the computer and data processing services industry will contribute strongly to the increased demand for these managers. In addition, employment growth is expected across a variety of industries reflecting the widespread importance of information technology.

Opportunities for those who wish to become engineering, natural science, and computer and information systems managers should be closely related to the growth of the occupations they supervise and the industries in which they are found. (See the statements on engineers, life and physical scientists, computer programmers, and computer systems analysts, engineers, and scientists elsewhere in the *Handbook*.)

Earnings
Earnings for engineering, natural science, and computer and information systems managers vary by specialty and level of responsibility. Median annual earnings of these managers in 1998 were $75,330. The middle 50 percent earned between $57,610 and $94,450. The lowest 10 percent earned less than $44,580 and the highest 10 percent earned more than $119,900. Median annual earnings in the industries employing the largest numbers of these managers in 1997 were:

Computer and office equipment manufacturing	$87,500
Electronic components and accessories manufacturing	79,000
Research and testing services	77,700
Computer and data processing services	76,800
Engineering and architectural services	74,300
Federal Government	73,200
State government, except education and hospitals	63,500

According to RHI Consulting, average starting salaries in 1999 for information technology managers ranged from $50,500 to well over $100,000, depending on the area of specialization. A survey of manufacturing firms, conducted by Abbot, Langer & Associates, reported

that in 1998, the median annual income of engineering department managers and superintendents was $85,600; the corresponding figure for research and development managers was about $75,400.

In addition, engineering, natural science, and computer and information systems managers, especially those at higher levels, often receive more benefits—such as expense accounts, stock option plans, and bonuses—than non-managerial workers in their organizations.

Related Occupations

The work of engineering, natural science, and computer and information systems managers is closely related to that of engineers, life scientists, physical scientists, computer professionals, and mathematicians. It is also related to the work of other managers, especially general managers and top executives.

Sources of Additional Information

For information about a career as an engineering, natural science, or computer and information systems manager, contact the sources of additional information for engineers, life scientists, physical scientists, and computer occupations that are listed in statements on these occupations elsewhere in the *Handbook*.

Farmers and Farm Managers

(O*NET 79999C, 79999D, 79999G, 79999J, 79999K, 79999L, and 79999M)

Significant Points

- Modern farming requires a combination of formal education and work experience, sometimes acquired through growing up on a farm or through internships now becoming available.
- Overall employment is projected to decline because of increasing productivity and consolidation.
- New developments in marketing and organic farming are making small-scale farming economically viable again.

Nature of the Work

American farmers and farm managers direct the activities of one of the world's largest and most productive agricultural sectors. They produce enough food and fiber to meet the needs of our Nation and for export.

Farmers may be owners or tenants who rent the use of land. The type of farm they operate determines their specific tasks. On crop farms—farms growing grain, cotton, and other fibers, fruit, and vegetables—farmers are responsible for planning, tilling, planting, fertilizing, cultivating, spraying, and harvesting. After the harvest, they make sure the crops are properly packaged, stored, or marketed. Livestock, dairy, and poultry farmers must feed, plan, and care for the animals and keep barns, pens, coops, and other farm buildings clean and in good condition. They also oversee breeding and marketing activities. Horticultural specialty farmers oversee the production of ornamental plants, nursery products—such as flowers, bulbs, shrubbery, and sod—and fruits and vegetables grown in greenhouses. Aquaculture farmers raise fish and shellfish in marine, brackish, or fresh water, usually in ponds, floating net pens, raceways, or recirculating systems. They stock, feed, protect, and otherwise manage aquatic life sold for consumption or used for recreational fishing.

Farmers make many managerial decisions. Their farm output is strongly influenced by the weather, disease, fluctuations in prices of domestic and foreign farm products, and Federal farm programs. In a crop operation, farmers usually determine the best time to plant seed, apply fertilizer and chemicals, harvest, and market. They use different strategies to protect themselves from unpredictable changes in the markets for agricultural products. Many farmers carefully plan the combination of crops they grow so if the price of one crop drops, they will have sufficient income from another to make up for the loss. Others, particularly operators of smaller farms, may choose to sell their goods directly through farmers' markets, or use cooperatives to reduce their financial risk. For example, Community Supported Agriculture (CSA) is a cooperative where consumers buy shares of a harvest prior to the planting season, thus freeing the farmer from having to bear all the financial risks.

Farmer works with technician to test dairy herd for butterfat content of milk.

Farmers who plan ahead may be able to store their crops or keep their livestock to take advantage of better prices later in the year. Those who participate in the futures market—where contracts and options on futures contracts on commodities are traded through stock brokers—try to anticipate or track changes in the supply of and demand for agricultural commodities, and thus changes in the prices of farm products. By buying or selling futures contracts, or by pricing their products in advance of future sales, they attempt to either limit their risk or reap greater profits than would normally be realized. They may have to secure loans from credit agencies to finance the purchase of machinery, fertilizer, livestock, and feed. Farming operations have become more complex in recent years, so many farmers use computers to keep financial and inventory records. They also use computer databases and spreadsheets to manage breeding, dairy, and other farm operations.

Farmers' tasks range from caring for livestock, to operating machinery, and to maintaining equipment and facilities. The size of the farm often determines which of these tasks farmers will handle themselves. Operators of small farms usually perform all tasks, physical and administrative. They keep records for tax purposes, service machinery, maintain buildings, and grow vegetables and raise animals. Operators of large farms have employees who help with the physical work that small-farm operators do themselves. Although employment on most farms is limited to the farmer and one or two family workers or hired employees, some large farms have 100 or more full-time and seasonal workers. Some of these employees are in nonfarm occupations, working as truckdrivers, sales representatives, bookkeepers, and computer specialists.

Farm managers guide and assist farmers and ranchers in maximizing the financial returns to their land by managing the day-to-day activities. Their duties and responsibilities vary widely. For example, the owner of a very large livestock farm may employ a farm manager to oversee a single activity, such as feeding livestock. On the other hand, when managing a small crop farm for an absentee owner, a farm manager may assume responsibility for all functions, from selecting the crops to participating in planting and harvesting. Farm management firms and corporations involved in agriculture employ highly trained professional farm managers who may manage farm operations or oversee tenant operators of several farms. In these cases, farm managers